## ART. II.—*Cases of Empyema, with Remarks, especially in reference to Paracentesis.*—By WM. PEPPER, M.D., one of the Physicians of the Pennsylvania Hospital.

CASE I.—A boatman, aged about forty-five years, came under my care in January 1844; he stated that during the spring of 1842, he had suffered with severe pain of the right side, followed by the usual symptoms of acute pleurisy. For the following two years and a-half he continued to suffer with more or less difficulty of breathing, slight cough, and emaciation, but was still enabled to support himself by vending oysters about the streets. About the middle of December 1844, he was suddenly seized with severe pain in the right axillary region, followed by excessive dyspnœa and total inability to remain in the horizontal position; on the 27th of the following month he entered the hospital, and then presented the following symptoms: Constant hectic fever, with considerable oppression, slight cough, and mucous expectoration; he reclined constantly upon his right side, and could not be induced to change his position. This side of the chest was distended, exceeding the left in circumference by about one inch, and the lower intercostal spaces were somewhat bulging; excepting at the summit of the lung no vesicular murmur could be detected; in the axillary region, however, the respiration was amphoric, and occasionally attended with metallic tinkling; in front the voice also had a peculiar metallic resonance. The percussion over the back and side was perfectly flat, whilst in front and near the nipple it was decidedly tympanitic; the line of dulness could, however, be varied by changing the position of the patient; succussion also elicited the peculiar gurgling or splashing sound indicative of the presence of liquid and gas in the thoracic cavity.

The patient remained in much the same condition up to March 1st, when it was evident that his dyspnœa had greatly increased; in addition to the above-mentioned physical signs, the heart was dislocated and could be felt pulsating beyond the left nipple, the liver also projected low down into the abdominal cavity. The expectoration had now become slightly puriform, and the respirations were about thirty-five to the minute, and entirely confined to the left side; at the same time the emaciation and prostration had perceptibly increased; but what was most worthy of observation were the crackling râles, prolonged expiration, and dulness of percussion, now detected under the right clavicle.

No important change, excepting the gradual failure of the powers of life, occurred up to the time of his death, which took place April 2d, or about two months after he first came under my care. The chief treatment pursued in this case, consisted in the administration of iodide of potassium, syrup of seneka combined with carbonate of ammonia, counter-irritation over the chest, and a nutritious diet.

The body was examined the following day. On puncturing the front of the right thorax there was an escape of gas sufficient to extinguish a candle held several inches from the orifice; a small trocar was then introduced between the seventh and eighth ribs near their angles, and was immediately followed by a gush of thick greenish pus. Upon opening the cavity of the thorax, the right lung was found compressed against the spine, and not more than an inch in thickness. The apex contained numerous small tubercles, and in that portion of the lung which corresponded with the mammary region, there was a perforation about the eighth of an inch in diameter, communicating with a small cavity, evidently the result of softened tubercle. The summit of the lung was adherent, but the rest of this organ, though compressed and coated by a thick layer of soft lymph, was not firmly attached to the posterior mediastinum. The right pleura contained at least one gallon of pus, but the ribs were not necrosed, as often happens under similar circumstances. The left lung contained a few disseminated tubercles.

In the above case, it would appear that the acute pleurisy contracted in the spring of 1842, was, from neglect or inefficient treatment, allowed to degenerate into chronic empyema; and it is highly probable that the tubercular perforation, followed by pneumothorax, occurred in December of 1844, at which time the patient complained of sudden and severe pain in the axillary region. The crude condition of the tubercles, as ascertained after death, renders it not unlikely that their development was consequent upon the pleurisy, and the direct result of a vitiated condition of the system induced by chronic irritation or purulent absorption. When the patient first came under my notice, the physical signs clearly indicated a fistulous opening into the lung; soon after this, the crackling and prolonged expiration under the clavicle induced the belief that the empyema was also complicated with tubercular deposit, and that, therefore, under these circumstances, but little was to be hoped for from paracentesis. At an earlier period, however, it is by no means improbable that this operation might have prolonged life, or even effected a permanent cure.

Case II.—June 7th, 1850, a young woman, aged twenty-three years, entered the hospital, suffering with considerable oppression and some cough. She stated that about eleven weeks before, she had been seized with severe pain in the right side, followed by fever, slight cough, and oppression; no treatment, however, had been pursued in her case up to the time of admission. She was now emaciated, but had no fever, though her pulse was frequent and feeble; the cough also was but little and entirely unattended by expectoration. The most marked symptom, however, was the excessive dyspnœa; and this was greatly increased by the slightest exertion. The right side was evidently distended, and exceeded the left by nearly two inches in circumference; throughout this side the percussion was perfectly flat, and no vesicular murmur could be heard over any part of the lung; along the spine, however, and particularly at the root of the lung, the respiration was loud and bronchial, whilst over the greater part of the left lung it was more or less masked by large mucous râles. The liver could be felt depressed below the margin of the false ribs, and the pulsations of the heart were visible beyond the left breast. A blister was applied over the diseased side, whilst calomel, squill, and digitalis were administered in connection with an occasional dose of senega and carbonate of ammonia. The above remedies could not, however, be perseveringly used, owing to the great irritability of the alimentary canal.

By the 14th, or one week after admission, the prostration had so far increased as to demand the use of stimulants, such as milk-punch, carbonate of ammonia, and Hoffman's anodyne; at the same time, the difficulty of breathing had become very distressing, and attended with blueness of the hands and lips, and coldness of the extremities. The patient was now in a more or less lethargic condition, and quite indifferent as to the ultimate result of her disease; and it was quite apparent, that unless relieved by surgical means, life must soon become extinct. In consultation, however, the operation of paracentesis was deemed inexpedient on account of the excessive prostration; the most powerful stimulants were now freely administered in the hope of rallying her strength, but in despite of these means she gradually sank and expired on the 18th, or about ten days after her admission into the hospital.

On examining the body the following day, the right pleura was found to contain two ordinary wash-basins full of serum, and the lung was coated by a thick layer of soft lymph, and closely compressed upon the spine by the superincumbent fluid; the mediastinum was forced far to the left side, and the liver was much engorged and greatly depressed. The right lung when incised closely resembled macerated flesh, and in its central portion there was apparently a small patch of inflammation; the left lung was perfectly healthy, as were the other organs.

The absence of hectic fever and purulent expectoration, in connection with the fact that the intercostal spaces were not bulging, or the superficial veins distended, led to the belief that the effusion was serum and not pus; and judging from the previous history of the case, there was no reason to suspect tubercular complication. The examination, *post-mortem*, confirmed these views, and strengthened me in the opinion, that if the operation had been performed even at the late period at which it was proposed, the patient might have been rescued from impending death: the mere fact that the lung was, in a great measure solidified and coated with lymph, cannot be considered as conclusive evidence of the utter impracticability of its ever having regained its natural condition, even had the compressing fluid been removed, for there is good reason to believe that, in many instances of a similar character, the lung has gradually unfolded as absorption progressed, and finally resumed its normal position and function.

CASE III.—A stone-cutter, aged about thirty years, came under my care in April 1850. He stated that about four months previous he had suffered with severe pleurisy of the right side, for which, however, he had been subjected to no kind of treatment; his previous health had been good, nor was there any hereditary tendency to pulmonary disease. When I first saw him he was emaciated and suffering with hectic fever; he also had slight cough and puriform expectoration with laborious breathing. The right thorax was distended, and the lower intercostal spaces bulging; over this side no vesicular respiration could be heard, but at the angle of the scapula there was loud amphoric respiration and resonance of the voice; when the patient was on his back, the percussion over the entire front of the right side was perfectly tympanitic, whereas when he assumed the sitting posture it became flat from above the nipple down to the margin of the ribs; moreover, a distinct splashing sound could be heard during the act of coughing. The heart was forced to the left, and the liver depressed, as is usual in case of extensive effusion of air or liquid into the cavity of the right pleura; the respiration throughout the left lung was puerile and evidently supplementary, but at the same time, more or less masked by loud, sonorous, and sibilant râles.

Squill and senega, combined with carbonate of ammonia, were given in connection with various tonics, without, however, affording any relief to his distressing symptoms. On the 16th of May, or about three weeks after my first visit, the percussion had become quite dull over the front of the right thorax, excepting, indeed, about a hand's-breadth under the clavicle where it still remained tympanitic; at the same time, there was slight swelling of the intercostal space between the sixth and seventh ribs, and the superficial veins in this region were considerably engorged. As it was evident that the effusion into the cavity of the chest had greatly increased within the last few days, and that the death of the patient was inevitable unless promptly relieved, I was induced to make a deep puncture with an ordinary thumb-lancet into the intercostal space between the sixth and seventh ribs, and about midway between the spine and sternum, corresponding with that part of the swelling where there was some evidence of deep-seated fluctuation. But a few drops of pus followed this procedure, and it was not until a moderate-sized canula, armed with a trocar, had been introduced through the original puncture, that any considerable amount of pus escaped. Upon this occasion, about one quart of thick and exceedingly offensive pus, occasionally mixed with air-bubbles, flowed through the canula; the orifice was now closed by a compress of lint secured by adhesive straps. The following day the patient appeared somewhat less oppressed, but there was no very material improvement in his condition; on removing the compress there was a gush of offensive pus, and it continued to flow until about the same amount had escaped as on the previous day; it was now observed that the percussion was tympanitic over a much larger extent than previous to the operation, but still the heart and liver had not regained their natural position; the purulent expectoration had, however, decidedly diminished during the last twenty-four hours. Wine, bark, beef-essence, and other supporting measures were pursued, but his strength gradually failed and he expired just one week after puncturing the chest; for several days preceding dissolution, not more than four or five ounces of pus escaped during the twenty-four hours.

The body was examined thirty-six hours after death. The right pleura was coated throughout by a thick layer of semi-organized lymph, and contained a large amount of fetid gas and pus, of the latter not less than two or even three quarts still remained; several of the ribs, including the sixth, seventh, and eighth, were denuded and in a state of necrosis. The lung was compressed against the spine and firmly bound down by old adhesions; in the upper lobe there was a large vomica lined by a cartilaginous membrane, and communicating with the cavity of the pleura by two fistulous openings; a few tubercles were scattered throughout the rest of the lung; the left lung also contained some disseminated tubercles; pericardium slightly inflamed; liver engorged; other organs healthy.

In this instance, the physical signs clearly revealed the existence of pneumothorax in connection with empyema, but it was quite impossible to determine whether the fistulous opening was the result of softened tubercles, or owing to ulceration of the pleura caused by the purulent collection. The previous history clearly showed that the disease commenced as an ordinary case of pleurisy, occurring in an individual of previous good health and without any hereditary tendency to consumption, and from these facts it appeared not improbable that the ulceration of the lung was consequent upon the neglected pleurisy; and so in regard to the scattered tubercles detected after death, they too may have been the result of purulent absorption or vitiation of the system from chronic disease. At the same time, it should be remembered that stonecutters are particularly liable to bronchial inflammation, sometimes even ending in pulmonary induration and ulceration; the patient, however, persisted in stating that up to the time of his pleuritic attack he had not suffered from cough, or other symptom of diseased lung.

For the above reasons, I am disposed to believe that if paracentesis had been performed at an early period of his disease, in all probability the lung would have escaped any serious organic disease; but even when this mischief was done, there was still reason to believe that the life of the patient might be prolonged, and further disease prevented by aiding nature in her efforts to get rid of the pus through an external opening, and it was with this view alone that the chest was punctured under so many unfavourable circumstances.

Case IV.—During the summer of 1849, I was requested to visit a man, aged thirty-five years, said to be suffering with consumption. Upon inquiry, I found that he had been ill for about three months, and that his attack had commenced with the usual symptoms of acute pleurisy. His previous health had been uniformly good, nor was there any hereditary predisposition to pulmonary disease. At the time of my visit, he presented the following symptoms: hectic fever, dyspnœa, cough, purulent expectoration—equalling about six ounces per day—and considerable emaciation. The left lung appeared perfectly healthy, but the right side was distended; and, excepting at the summit, no vesicular murmur could be detected. In front and behind, however, the respiration was amphoric, and frequently associated with metallic tinkling and gurgling, particularly when he coughed or suddenly moved from side to side.

Up to the expiration of one month from the time I first saw him, there was no notable change in the symptoms, but it was then observed that the intercostal space between the sixth and seventh ribs was red and swollen, and also attended with indistinct fluctuation. The patient's strength had been sustained throughout by bark, wine, and beef-essence; and a flaxseed poultice was applied over the inflamed part. On the following day, the most prominent part of the swelling was punctured with a lancet, which was immediately followed by six or eight ounces of thick pus, very similar to that which he had been expectorating for the last month; and throughout the further progress of the case it was observed that, when the external orifice was obstructed, the expectoration increased. Upon several occasions when the patient coughed, the pus commingled with air was driven through the opening with explosive force. From day to day the expectoration and discharge from the side became less and less, whilst at the same time his strength gradually improved under the use of tonics and a nutritious diet; and, in one month from the time of puncturing the chest, he left for the country in a greatly improved state of health.

Three months after this he visited me at my office, and then presented the following condition: But little cough or expectoration, and, for the last two weeks, the opening in the side had entirely healed; he had also gained flesh; and, in fact, his whole condition had so far improved that it was with difficulty I recognized him as my former patient. The right thorax was much contracted, and the shoulder of the same side greatly depressed; the respiration throughout this side was still very feeble, and in a measure masked by sonorous rales; on the left, however, it was perfectly natural, or, perhaps, a little louder than usual. The patient was now about to resume his business, and from that time to the present I have not heard from him.

Here, then, was a case of empyema associated with pneumothorax and great derangement of the constitution, and yet the patient in a great measure recovered from these serious lesions, and was once more enabled to enter upon the duties of life; nor can I divest myself of the idea that his restoration was, in a great measure, owing to the external opening. The fistula of the lung, in the present instance, was, most probably, the result of the pus ulcerating its way through into the bronchial tubes; but the escape of pus through this channel was so slow that irreparable injury to the lung, and, probably, even death itself, must have been the result without the counter opening in the side.

During the summer of 1846, several cases somewhat similar to the above were admitted into the Pennsylvania Hospital; two of which presented a marked improvement in the symptoms upon the escape of pus from an opening in the side, and they both ultimately left the institution in a greatly improved state of health. An abstract of these cases, as reported by Dr. H. Hartshorne, formerly one of the resident physicians, may be found in the *American Journal of Medical Sciences* for October, 1848, p. 349.

CASE V.—In the spring of 1850, I was requested by a medical friend to visit a lady, aged about thirty, suffering with an acute attack of pleuro-pneumonia of the left side. From this she recovered but imperfectly, and, in the month of June, was sent into the country in the hope of restoring her feeble health. On the 5th of August, I was again requested to visit the patient, whom I then found suffering with all the symptoms of a local empyema, confined to the lower half of the left thorax. To the left of the cardiac region there was a pulsating tumour about the size of half a hen's egg. The swelling was painful to the touch and indistinctly fluctuating, and, by gentle pressure with the palm of the hand, it could be reduced in size—thus clearly showing that it communicated with the cavity of the pleura. Under these circumstances, it was deemed expedient to puncture it, and this trifling operation was followed by a large discharge of healthy pus, to the great relief of the suffering patient. From time to time, I have visited this lady, and made the following note of her case in the latter part of September, 1851, or about eighteen months after the operation: Left side contracted and shoulder somewhat depressed. Discharge of about two ounces of healthy pus from the side per day, but the quantity is variable, and alternates with the expectoration of the same kind of matter. At times, when she coughs, air and pus are forcibly expelled from the external orifice. She is now able to attend to her usual occupations, and can walk a mile or more without fatigue. The appetite is good, nor is there any hectic fever; but she still remains thin, and is occasionally somewhat oppressed, particularly when the external orifice is temporarily closed. The respiration and percussion are natural on the left side, excepting over a space of about four inches square near the root of the lung, where the percussion is flat and the respiration loudly bronchial. Over this part, also, there is great vocal resonance.

From the above symptoms, it was inferred that there still existed a circumscribed abscess of the left pleura, communicating with the large bronchial tubes by a small fistulous opening—the surrounding pulmonary tissue being in an indurated condition. For the last year she has, with temporary omissions, persevered in the use of cod-liver oil, iron, and quinia; and, judging from her present improved condition, it is by no means improbable that she may be ultimately restored to perfect health.

In this, as well as in most of the above cases, I feel fully persuaded that, without the external opening, the chances of recovery would have been greatly diminished; and, indeed, in several instances, speedy dissolution must have been the inevitable result save for this cause. In every case, prompt relief followed the external discharge, and, whenever this was even temporarily arrested, the patient's distress was greatly increased.

The operation of paracentesis thoracis has at all times been viewed with more or less distrust by many distinguished members of our profession; and although this prejudice is now rapidly disappearing, owing to the numerous instances in which the most beneficial results have followed the operation, there still remains much discrepancy of opinion as to the particular circumstances under which this procedure is justifiable. And, indeed, it will be found upon impartial investigation, that most of the disastrous results consequent upon it are fairly attributable to a want of proper discrimination in the selection of cases. Formerly, when the profession was in a great measure ignorant of the physical signs indicative of effusions into the pleural cavities, it is not surprising that numerous instances of erroneous diagnosis and consequent faulty practice should have occurred; such as puncturing an enlarged liver or spleen, or medullary tumour, under the impression that fluid existed in the thoracic cavity; or even opening the sound, instead of the diseased side, when such effusion absolutely existed, and thus giving rise to collapse of the healthy lung, and consequently to speedy dissolution. But now that the physical signs are known to afford great certainty in determining the extent and character of thoracic disease, such errors cannot occur, except as the result of culpable ignorance or carelessness; and it is owing to the great improvement in this department of our science that the operation of paracentesis is beginning to be viewed with more favour by the profession.

It would be a work of supererogation, at the present time, to enter fully into details in regard to the physical signs indicative of intra-thoracic effusions, and my remarks under this head shall, therefore, be as brief as possible. Dulness on percussion is one of the most important indications of such a condition, and it exists to even a greater degree than in pneumonia, whilst at the same time the elasticity of the chest is entirely destroyed; in those cases where the pleural sac is not filled with fluid, the line of dulness can generally be varied by changing the position of the patient; occasionally, however, the fluid is limited by adhesions, and therefore, uninfluenced by position. The distension of the chest should next claim our attention: in some instances, the circumference of the diseased side will exceed the healthy by one or two inches; whilst at the same time the intercostal spaces may be distended or bulging. In extreme cases, the heart will be displaced to the right or left, and the liver depressed by the superincumbent fluid. The absence of all vocal vibration also, constitutes an important indication. In like manner, auscultation is all important in forming our diagnosis; thus, when the fluid is not considerable, a distinct agophonic resonance of the voice, and a peculiar modified bronchial respiration can generally be heard over the back and even in the axillary region; whereas, when the accumulation is very great these phenomena entirely disappear, or, at most, can only be heard over the root of the lung; where most of the above signs co-exist, as is generally the case when there is an extensive effusion, it would be quite impossible to fall into any serious error as to the true nature of the disease. At the same time, however, it is important to attend to the previous history and accompanying functional disorders; such as dyspnœa and inability to lie on the sound side, paucity of cough and expectoration.

That there are cases of effusion, puriform or otherwise, which are not manifested by the above symptoms must be conceded; as, for instance, when the fluid is confined between the lobes of the lung, or between the latter and the diaphragm; and it is also well known, that when the effusion is but moderate and of gradual formation, no marked dyspnœa is induced, nor are the viscera displaced, or the side distended. It may happen in cases of local effusion, and where partial absorption has taken place, that the chest may even be contracted; but under the above circumstances paracentesis is not called for, and no objection can, therefore, be urged against this operation from these occasional difficulties in diagnosis. Encephaloid degeneration of the lung has, in several instances, been mistaken for empyema; and when we bear in mind, that in this latter affection the percussion may be perfectly flat, the side distended and elastic, the viscera dislocated and all respiratory sounds and rales entirely absent, it must be confessed, that much discrimination is necessary in forming our opinion as to the true nature of the case. In one instance, where "the question had been agitated as to whether paracentesis of the chest might be advisable," Dr. Stokes was enabled to pronounce upon the cancerous character of the affection mainly by the varicose condition of the veins of the diseased side, and the currant jelly-like sputa, in connection with the previous history of the case. These peculiarities do not always attend cancerous degeneration of the lung; and, moreover, it should be remembered that this disease is frequently complicated with empyema, rendering the diagnosis more and more obscure. The fact, that encephaloid degeneration of the lung is generally associated with tumours of a similar character occupying the mediastinum, and pressing upon the important organs contained in this region, will of itself frequently enable us to form a correct diagnosis; since, under these circumstances, we have violent pain in the neck or shoulder, with œdema of the face, chest and arm, in connection with dysphagia, hoarseness, and other symptoms caused by the pressure of the tumour. Moreover, cancer of the lung is commonly attended with that peculiar condition of the system denominated cancerous cachexia; and not unfrequently, we at the same time find malignant tumours occupying some of the external parts, as the glands of the neck or sides of the chest; the previous history of the case will also greatly aid us in forming a correct opinion as to the true nature of the disease. The only other affection of the lung likely to be confounded with empyema is chronic pneumonia; but in this disease the pulmonary induration is clearly indicated by the increased vocal resonance and vibration, want of distension of the side, viscid sputa, and mucous rales.

Enlargement of the liver has occasionally been mistaken for empyema; but such an error could always be avoided by strict attention to the physical signs already enumerated, such as dislocation of the heart, prominence of the intercostal spaces, and bronchial respiration at the root of the lung; besides which, the previous history and accompanying symptoms could not fail to remove any remaining doubt. These two affections are, however, very frequently associated; for not only is the liver depressed in empyema by the superincumbent fluid, but, owing to the pressure of the collapsed lung and fluid upon the ascending cava preventing a free return of venous blood to the right auricle, it is also frequently much engorged. This condition, according to Dr. M'Donnell (*Dublin Journal of Med. Sci.*, 1844), occurs as well in empyema of the left as of the right side, and is owing to the supplementary action imposed upon the liver by the imperfect decarbonization of the blood in the lungs. Whatever may be the true explanation of this congestion, its existence certainly forms an important feature in the history of empyema, particularly in reference to the operation of paracentesis. The above author, also, reports several cases of "pulsating empyema" of the left side, where the puriform matter in the external cellular tissue communicated with the intra-thoracic abscess, and thus received the indirect impulse of the heart. Under such circumstances, it is conceivable that these pulsating swellings might by the careless observer be mistaken for an aneurism, or a cancerous tumour; but the locality of the swelling, its fluctuation, the absence of thrill and rasping sound, in connection with the extensive dulness of percussion and other physical signs of empyema, would at once distinguish it from an aneurism; whilst the absence of the cancerous cachexia, and of the peculiar elasticity so characteristic of medullary tumours, would clearly show its non-malignant character. A mere abscess of the cellular tissue not communicating with the cavity of the thorax could hardly be mistaken for empyema, since it would neither be increased by cough or diminished by pressure, as is generally the case when the external swelling forms but a part of the intra-thoracic effusion. In like manner, by attending to the physical signs, functional disorders, and previous history, an hepatic abscess can readily be distinguished from empyema.

Pulmonary tubercles are so frequently associated with empyema, that it becomes exceedingly important to direct our attention to this complication, particularly when paracentesis is proposed, since the ultimate success of the operation must, in a great measure, depend upon the perfect integrity of the lungs. When the tubercles are numerous or softened, giving rise to solidification or vomica, the true state of the case is at once revealed by auscultation and percussion; but on the other hand, when they are small and disseminated, their presence is not indicated by any marked physical signs, and we are then obliged to rely more upon the previous history and general symptoms. It is worthy of observation, however, that in uncomplicated empyema, the lung of the sound side, owing to its supplementary action and increased determination of blood, is generally more or less congested; and it is, hence, no uncommon occurrence to find the respiratory murmur, in a measure, obscured by various rales, which might readily induce the belief that the disease was complicated with bronchitis or tubercles; under these circumstances, the expectoration occasionally becomes puriform (owing, as it has been supposed, to a species of vicarious action), and thus tends to confirm the erroneous impression. At other times, the puriform sputa may proceed from a fistulous opening between the pleural cavity and the bronchial tubes of the compressed lung; in such cases, however, the pleural sac generally contains more or less air, as evinced by the tympanitic percussion, and the peculiar gurgling induced by succussion. Under these circumstances, it becomes important to ascertain whether the fistula has been caused by tubercular perforation, or by the corrosive action of the pus in the pleura. When it can be ascertained that the patient, after suffering for some time with cough, or other symptom of pulmonary irritation, has been suddenly seized with acute pain in the axillary region, followed by extreme dyspnœa, we may reasonably conclude that any pleuritic effusion consequent upon such a seizure has been the result of tubercular perforation; whereas, when the symptoms of pleurisy have occurred in the midst of perfect health, followed by a gradually increasing difficulty of breathing, and, at a still more remote period, by a sudden and very copious discharge of pus from the lungs, there can be but little doubt that the fistulous opening has been caused by the empyema bursting into the bronchial tubes. In those cases where the disease had been observed throughout, the physical signs would prevent all error upon this point. In connection with the diagnosis of empyema, it is important to observe, that, when this disease is complicated with pneumothorax and purulent expectoration, it by no means follows that a fistula of the lung necessarily exists; the air in the pleural sac may be evolved by the unhealthy pus, and this is particularly the case where there is necrosis of the ribs. In several instances of this kind, no opening into the lung could be found, notwithstanding the most minute examination; after filling the cavity of the pleura with water, the collapsed lung was forcibly inflated, but no air could be seen to bubble up from its surface; in like manner, a most careful dissection of the false membranes failed to detect any fistulous opening. I may also mention, that in two of the cases, the gas contained in the pleura was tested with lime-water, without affording any milky precipitate, as unquestionably would have been the case had it contained any carbonic acid from the lungs; when treated, however, with a solution of corrosive sublimate, it gave a black precipitate, clearly indicative of sulphuretted hydrogen. In regard to the purulent expectoration, under these circumstances it has been supposed to be a species of vicarious discharge from the mucous membrane of the bronchial tubes both of the diseased and healthy side; Drs. Stokes, Green, and M'Donnell, entertain this opinion, and allude to cases of recovery by purulent expectoration quite independent of any fistulous communication between the cavity of the pleura and lung; the last named author states that he has occasionally known empyema to be removed by a spontaneous diarrhœa.—(*Dublin Journal of Medical Science* for March 1844.)

It still remains to be considered whether there are any means by which the character of the pleuritic effusion can be positively ascertained. The mere intensity of the symptoms is no evidence of puriform effusion, since this may result from a low grade of inflammation, whilst, on the other hand, the most severe forms of pleuritis frequently end in effusion of serum and lymph; nor is the long duration of the effusion any proof of its puriform character, inasmuch as it is well known that serum may remain in the pleural sac for many months without undergoing any important change. Hectic fever has always been considered as more or less characteristic of empyema, but occasionally this disease exists without any considerable constitutional irritation; so that, from the previous history and general symptoms alone, we could but arrive at a probable opinion; more positive indications, however, may be derived from simple inspection of the chest. In cases of empyema, the lower intercostal spaces are frequently bulging to a much greater extent than ever occurs in hydrothorax, whether mechanical or inflammatory; whilst, at the same time, the superficial veins are oftentimes distended and tortuous. These peculiarities are probably owing to the high specific gravity of the fluid distending the intercostal spaces, and at the same time pressing upon the deep-seated veins, thus obliging the venous blood to return to the heart by a circuitous route. Dr. Stokes believes that the intercostal bulging depends more upon imperfect innervation or paralysis of the muscles than upon the mere pressure of the pus; Dr. Roe is also of the opinion that a moderate amount of pus may by its irritating properties cause a relaxation or paralysis of the intercostal muscles, so as to give rise to a greater degree of distension than could be produced by the pressure of a much larger quantity of serum.

After this brief view of some of the most prominent symptoms of empyema, particularly in reference to its diagnosis, it may not prove uninteresting to inquire under what particular circumstances the operation of paracentesis may be indicated. In uncomplicated cases, and where the amount of pus is so considerable as to cause much distress, we see no good reason why the operation should be delayed. In opposition to this view, however, it may be urged, that by further procrastination the pus might ultimately find vent through the lung or intercostal spaces, or by both these routes, and be followed by the restoration of the patient, as has repeatedly happened under similar circumstances; and, moreover, even without such openings, it is alleged that recoveries have taken place by a vicarious discharge from the bronchia or alimentary canal. But when it is remembered, that our therapeutic agents have but little influence in promoting the absorption of pus, that these agents, such as mercury, purgatives, &c., are contra-indicated in the impoverished state of the system which generally attends empyema, and that even supposing the pus might be absorbed, nothing but the most disastrous effects could result, such as metastatic abscess and other consequences of purulent infection; it certainly does not appear reasonable to procrastinate in the forlorn hope that the unaided efforts of nature may open some safe channel for its escape. In the consideration of this question, it should also be recollected that the longer the pus is allowed to remain in the pleura the greater is the risk of carnification of the lung, necrosis of the ribs, and other serious complications. The chief objection, however, urged against paracentesis, is the alleged injurious effects resulting from the admission of air into the pleural sac; but it is now generally conceded that all apprehensions on this point have been, in a great measure, unfounded. In twenty-four cases reported by Dr. Roe, the admission of air produced no detriment either by its pressure or decomposing influence, and numerous cases of a similar character might be collected from the different periodicals; this view is also in a measure confirmed by the well known fact that in traumatic pneumothorax, from fractured rib, or clavicle, the air produces no injurious effect, but is gradually absorbed as the cicatrized lung becomes inflated and restored to its natural position. But even supposing that the objection thus urged was valid, it certainly could be applied with equal force to the fistulous openings resulting from the corrosive action of the pus when abandoned to itself; when the lung has thus been perforated, it is no longer susceptible of expansion, but must remain collapsed until the fluid contents of the pleura are discharged, and the fistulous opening healed; on the other hand, when the pus has worked its way externally through the intercostal spaces, the openings are often tortuous or ragged, easily obstructed, and frequently associated with necrosis of the ribs. An appeal to facts also shows that the operation is fully sustained by experience: of sixteen cases of empyema, reported by Dr. T. Davis, in which paracentesis had been performed, twelve recovered; and of forty-four cases collected and reported by Dr. H. Roe, in the *Medico-Chirurgical Transactions*, vol. xxvii., the operation proved successful in thirty-two instances, showing that more than two-thirds, or nearly three-fourths of the whole number recovered. Besides those just alluded to, numerous other successful cases have recently been reported in the various journals both of Europe and this country; and amongst the advocates for the operation may be enumerated many of those best qualified to form a correct opinion in thoracic diseases, such as Forbes, Stokes, Williams, Watson, and numerous others equally entitled to respect upon this subject.

When, however, the empyema is attended with a fistulous opening of the lung, sufficient to allow the pus to escape freely by expectoration, paracentesis is certainly not called for; but when the opening is small, or so obstructed as to prevent the free passage of the fluid and thus give rise to increased oppression, a counter-opening in the side is clearly indicated; by this procedure not only will the pus be more rapidly and safely evacuated, but the perforation of the lung may heal, and thus allow the collapsed organ to regain its natural dimensions. When tubercles exist, with or without perforation of the lung, the expediency of the operation is, to say the least, extremely doubtful; and the most that can be hoped for from it, under these circumstances, is a temporary prolongation of life. Much of the disrepute, which is by some attached to paracentesis-thoracis can, in a great measure, be traced to the fact that cases similar to those just referred to, have but too often been subjected to this operation.

Thus far allusion has chiefly been made to paracentesis as applicable to empyema or purulent collections in the cavity of the pleura, and it now remains to add a few words in regard to its expediency in hydrothorax, whether acute or chronic, mechanical or inflammatory. Rapid and very copious effusion as the result of acute pleurisy occasionally gives rise to the most distressing orthopnœa, or even speedy dissolution; under such circumstances, the action of medicines may prove too tardy for the relief of the patient, and as asphyxia is imminent, puncturing the chest is not only admissible, but absolutely demanded by the urgency of the case. It is well known that, as a general rule, pleuritic effusions can be removed by appropriate treatment, such as bleeding, calomel, squill and digitalis, the various hydragogue cathartics, diuretics, diaphoretics, and blisters; but, occasionally, all these means fail to promote absorption, whilst at the same time the effusion is gradually increasing and threatening a protracted and agonizing death; in such instances nothing but a resort to paracentesis can save the life of the patient, and it is incumbent upon the physician to recommend its performance before the powers of life have so far failed as to prevent the system from rallying after the removal of the fluid. In Europe, and particularly in France, this operation is frequently adopted in cases of extensive and recent pleuritic effusion, and it must not be concealed that, in some instances at least, there is reason to believe it has been resorted to prematurely; but, whilst in this disease as in croup, the operation should only be viewed as a dernier resort, it is still important that it should not be delayed until asphyxia has so far progressed as to materially interfere with its ultimate success. In many cases of inflammatory hydrothorax, the pleura is completely invested by a thick layer of lymph; and, under these circumstances, it is apparent that the fluid contents can be but slowly absorbed, or may even become as it were encysted, and there remain for many months or years without undergoing any important change; in such cases, though delay may not lead to ulceration of the lung or necrosis, as in case of empyema, it is evident that but little is to be hoped for from our therapeutic agents or the expectant plan of treatment; and that, therefore, paracentesis should be resorted to whenever the oppression is very considerable, more especially so, since the longer this operation is deferred the greater will be the difficulty in the lung regaining its natural position.

Dr. Roe reports in all some twenty-six cases of inflammatory hydrothorax, in which paracentesis had been performed, and of these, seventeen recovered; showing, at least, that this procedure is not as hazardous as has been by some supposed. Other instances might be adduced to show that a timely resort to the operation might, in most instances, save the life of the patient.

In mechanical hydrothorax, where the effusion depends upon disease of the heart, or forms but a part of general dropsy, as in the advanced stage of granular degeneration of the kidneys, nothing but temporary relief could be expected from tapping the chest; the effusion here forms but an accidental complication to a more serious disease which has already impaired the powers of life; and hence it is, that paracentesis is attended with much danger under these circumstances. Dr. Davis reports three cases of this character, in all of which the operation proved fatal; other fatal cases have also been recorded; and hence this practice has been in a great measure abandoned in this form of hydrothorax.

In regard to the operation itself, there are some points upon which a few remarks may not be inappropriate at the present time. Some discrepancy of opinion still exists as to the exact locality where the puncture should be made; but, it is now generally conceded, that the most eligible position is in the fifth intercostal space, about midway between the sternum and spine, or just posterior to the digitations of the serratus major; this part of the chest being generally most free from adhesions, and at the same time sufficiently remote from the other important organs. When the fluid points externally, constituting "empyema by necessity," the puncture may be made with a lancet in the most prominent and yielding part of the swelling; but, in all other instances, a small sized trocar, such as is used for tapping in hydrocephalus or hydrocele, should be preferred, the point of the instrument being exceedingly sharp so that the false membranes which occasionally line the costal pleura, may not be carried before it, and thus frustrate the operation. By some, it is recommended that the fluid should be removed as far as practicable at the time of the operation; and with this view, it is urged, that pressure should be made over the epigastrium and side of the chest; but, in regard to this question, much must depend upon the condition of the patient, the character of the fluid, and duration of the disease. When the lung is much compressed and bound down by false membranes, it would not be desirable, even were it practicable, to draw off all the fluid at once, nor would it be prudent to pursue this course in feeble and exhausted subjects; the most that should be done under these circumstances, would be to allow an escape of fluid sufficient to remove the tension and oppression caused by the displacement of the mediastinum and diaphragm, the rest being allowed to flow off from day to day in accordance with the contraction of the chest, the expansion of the lung, and the rallying strength of the patient. Much the same plan is recommended by Dr. R. Townsend, in his elaborate article on empyema, in the *Cyclopædia of Practical Medicine*, where he states that the fluid should be allowed to escape only so long as the stream continues full and uninterrupted, and till tension is removed: a similar opinion is also entertained by Dr. Stokes, and other writers of note. In recent cases of empyema or serous effusion, and where there is good reason to believe that the lung is neither carnified or bound down by lymph or false membrane, the fluid may be evacuated at once, since the lung will gradually rise as the superincumbent pus or serum is removed. So long as any pus remains in the cavity of the pleura, the puncture will generally remain open; and it will also be found, that as the tension is removed, the external orifice will no longer correspond with the opening through the intercostal space, so that it is not necessary to render the integuments tense before making the puncture, as has been recommended with the view of forming a valvular opening, and thus preventing the entrance of air. Occasionally, however, the opening is disposed to close, and under these circumstances it is expedient that the orifice should be dilated by a small piece of waxed sponge or lint secured by an adhesive strap: some, on the other hand, have preferred that it should heal, and the operation be repeated from time to time according to the necessity of the case. A remarkable instance of this kind may be found in the *London and Edinburgh Monthly Journal*, for 1850, reported by Dr. Peddie, in which twelve distinct operations were performed in the course of three years, at the end of which time the patient's health was entirely restored; the whole amount of pus removed being about four gallons. In case of more serous effusion, there can be no doubt as to the propriety of allowing the puncture to close; for, under these circumstances, the fluid that may remain will frequently be absorbed, or, at least, it can have no injurious effect upon the lung or ribs as in the case of puriform matter; nature also appears to point out this course, since in most instances where the chest has been punctured for serous effusion the wound has promptly healed; whereas in cases of empyema, it has been known to remain open for many years without very materially interfering with the general health. With the view of effecting a radical cure in case of chronic empyema, it has been recommended to inject the pleural sac with various astringent or stimulating fluids, such as decoctions of white oak bark, or solutions of iodine; in several instances the fluids thus injected have appeared in the expectoration, owing to the existence of a fistulous communication between the bronchia and pleura, and yet the patients have ultimately recovered. In the *Western Jour-*

*nal of Medicine and Surgery* (May, 1845), a case of successful treatment by injection of white oak bark is reported by Dr. Sneed, and others of a similar character have been recorded, but the propriety of such a procedure requires confirmation by more extended observation.

When the lung has been long compressed and is, at the same time, firmly bound down by old adhesions, it can never regain its natural position by the mere removal of the superincumbent fluid; and hence it is that the side must remain permanently contracted; in many instances, however, of this kind the side does not become so far sunken as to reach the collapsed lung, so that a small space occupied by pus or serum still remains between it and the ribs, and under these circumstances, fistulous openings have been known to remain for the remainder of life. At other times, the lung of the sound side, owing to its increased function, becomes hypertrophied, and by displacing the mediastinum finally obliterates the sac remaining on the diseased side: within a few months I examined the body of a man, who, for two years previous to his last illness, had suffered with chronic pleurisy of the left side; the lung of this side did not exceed the size of his fist, and yet the sac of the left pleura was completely obliterated by the contraction of the chest and the displacement of the mediastinum from the pressure of the right lung, which had attained an unusual development; the heart, of course, was also forced to the left side. Dr. Stokes, however, attributes the dislocation of the heart in such cases, rather to the contraction of the mediastinum than to its displacement by the hypertrophied lung; and in those cases where the absorption has been exceedingly rapid, this most probably is the true explanation.

The peculiar deformity resulting from the absorption or removal by paracentesis of extensive pleuritic effusion, is greatly modified by the age of the patient and the duration of the disease. When recent, the contraction of the chest and consequent depression of the shoulder rapidly disappear as the lung regains its natural dimensions; but the reverse of this is true when the disease has been of long standing, and the lung long compressed and invested by false membranes. In adults, or at a more advanced age, owing to the firmness of the osseous structure, the deformity is generally much less than in early life; and for the same reason the displaced parts are much slower in regaining their natural positions, requiring sometimes a period of several years; whereas, in childhood, the parts being more yielding, the displacements are more extensive and rapidly formed, and at the same time much sooner restored to their normal condition. Quite recently, I had under my care a little girl aged about three years, suffering with acute pleurisy and extensive effusion; absorption progressed rapidly, and at the end of two months the chest was greatly contracted, the shoulder depressed, and the spine curved to such an extent that the little patient completely lost her balance, and in attempting to walk would fall towards the deformed side; and yet, notwithstanding the great displacement of parts, she had entirely regained her usual figure at the expiration of about four months from the commencement of her disease. In the fall of 1849, I saw, in consultation with Drs. Fox and Morris, a little child, aged eighteen months, suffering with acute empyema of the left side; in this instance, paracentesis was performed by the first named gentleman, and although the chest became excessively contracted, the deformity had nearly disappeared by the end of eighteen months, at which time the general health was also entirely restored. I forbear, however, entering into further details of this very interesting case, since it will be reported in full at some future period by Dr. Fox.

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## ART. III.—*Summary Report of the Hospital Department of the U. S. Frigate Cumberland, during a cruise to the Mediterranean, from July 19th, 1849, to July 9th, 1851.* By EDWARD R. SQUIBB, M. D., Assistant Surgeon U. S. N.

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| The ship was in commission during . . . . | 719 days. |
| At anchor in the various ports, . . . . | 541 " |
| At sea, . . . . . . . . . | 178 " |
| Entire distance sailed, by log, . . . . | 18,266 miles. |

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| Original number of officers and men on board, . . | 493 |
| Received during the cruise, to supply deficiencies, . . | 109 |
| Total number making any portion of the cruise, . . | 602 |

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| From these were transferred sick, . . . . . . | 52 |
| " " transferred to other ships, . . . . | 70 |
| " " discharged, . . . . . . . | 32 |
| " " deserted, . . . . . . . | 17 |
| " " died, . . . . . . . . | 13 |

Of the total number 351 made the entire cruise on board.
" " " 251 made a part of the cruise only.
" " " only 92 escaped the register of sick, and of these 9 had been on board less than three months.

The extreme ages on board were 15, and 64 years; 56 persons below the age of 21, and 15 above 49.

The average age in 472 individuals, from whom it could be obtained with tolerable accuracy, was 28 years nearly.

Of the total number, the places of birth ascertained with the greatest care and pains, are as follows:—

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| Born in the United States, including 43 officers, . . | 238 |
| " " Ireland, . . . . . . . . | 107 |
| " " England, Wales, and Nova Scotia, . . . | 60 |
| " " Germany and Holland, 4 in Prussia, . . | 42 |
| " " Italy, Sicily, and 2 in Malta, . . . . | 28 |
| " " Sweden, Denmark, Hanover, Norway, and Finland, | 25 |
| " " Scotland, . . . . . . . . | 21 |
| " " France, and French Canada, . . . . | 16 |
| " " Spain, and West Indies, . . . . . | 7 |
| " " Austria, . . . . . . . . | 5 |